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## Greenways As Resilient Global Landscape Solutions

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### Introduction

Greenways historically have been highly valued for their benefit to human health and wellness as linear recreational corridors and as a product of interconnected walking and bicycling trail networks. With the threat of accelerating global climate change, greenways offer a more important and strategic landscape for the protection of coastal and shoreline communities, mitigating the impacts associated with urban flooding, and providing landscapes that protect the health, safety and welfare for millions of coastal and shoreline residents around the world.

Each day millions of residents worldwide are exposed to the impacts resulting from global climate change, primarily from urban flooding. In 2003, 3 billion people lived within 200 km of a coastline or shoreline. (Figure 1) By 2025 that number will double.<sup>9</sup> In the United States, 39% of the population, an estimated 123 million people live in counties directly on a coastline or shoreline. This population is expected to increase by 8% from 2010 to 2020.<sup>10</sup> These shoreline residents are being impacted more frequently by flood events.

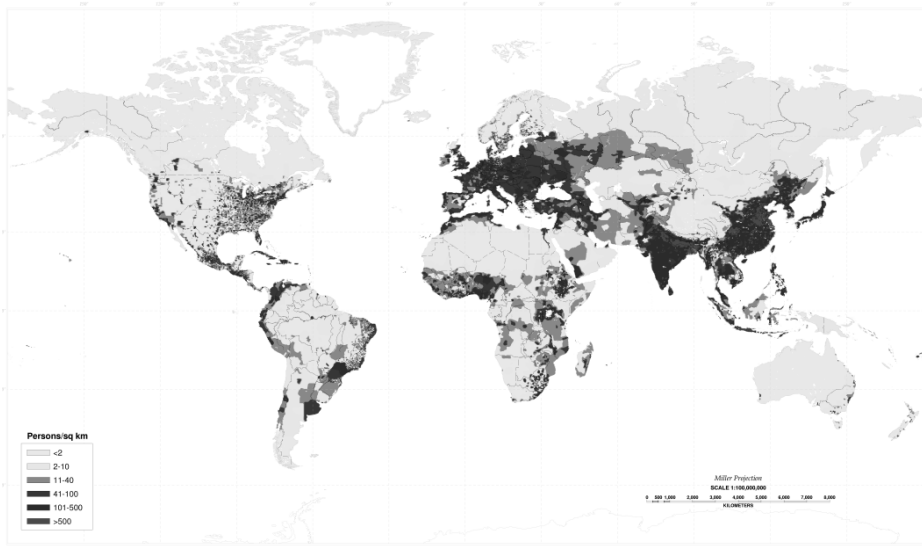
The full impact of river flooding on urban areas has also been realized in Western and Central European cities during 2002, 2013, 2014 and 2015. Historically significant rain events have swamped cities along the Elbe and Danube rivers with excessive rainwater, specifically in Austria, Belarus, the Czech Republic, Germany, Hungary, Poland, Serbia, and Switzerland.<sup>11</sup> The 2013 floods coincided with one of the wettest weather patterns of the past 156 years. Additionally, the frequency of the rain events, with significant floods occurring in three consecutive years, makes it imperative to consider broad regional and systemic solutions to the problem of “main stem” river flooding. How can the implementation of watershed oriented greenway systems lessen the impact of urban flooding, resulting in more sustainable and resilient communities?

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<sup>9</sup> Population Reference Bureau, 2015

<sup>10</sup> National Oceanic and Atmospheric Administration, 2010

<sup>11</sup> Wikipedia, 2013 European Floods



**Figure 1: Global Population in Proximity to Coastline or Shoreline (U.S. Department of Agriculture)**

### **Greenways as Resilient and Sustainable Landscape Solutions**

The English translation of “resiliency” means “*the capacity to recover quickly from difficulties, the ability to spring back to shape, and the ability to become strong, healthy or successful again after something bad has happened.*”<sup>12</sup> Urban resilience is defined as “*the capacity to prepare for, respond to and recover from significant multi-hazard threats with minimum damage to public safety and health, the economy and security of a given urban area.*”<sup>13</sup> Cornell University, Ithaca, New York, completed a report on urban resilience titled “Rust 2 Green” which defines urban resilience as an understanding of “*people and nature as linked and equated players in socio-ecological systems that are in fact always in flux and subject to change and disturbance.*”<sup>14</sup>

In 2013, the Rockefeller Foundation launched a new program aimed at helping cities become more resilient and sustainable, with the purpose of engaging “*in a global conversation about urban resilience and what we can all do to make our cities places of growth and opportunity now and in the future.*”<sup>15</sup> The “100 Resilient Cities” initiative seeks to identify the acute shocks and chronic

<sup>12</sup> Webster’s Dictionary, 2016

<sup>13</sup> Wikipedia, 2016

<sup>14</sup> Cornell University, Rust 2 Green, 2015

<sup>15</sup> Rockefeller Foundation, 2013

stresses that afflict cities, and provide both financial and institutional support to mitigate those impacts.<sup>16</sup> Under the Rockefeller Foundation program, resilient cities are thought of as “*robust, resourceful, flexible, redundant, inclusive, integrated and reflective.*” The Foundation’s “*city resilient framework*” focuses on health and wellbeing, economy and society, infrastructure and environment, as well as leadership of the city.

Ahern (2013) states that “*when cities are understood and accepted as dynamic, self organizing systems, the concept of sustainability changes. Rather than aspiring to develop spatial form with associate ecosystem services, sustainability is challenged to build the resilience capacity of cities.*” Ahern defines five strategies for building resilience, capacity and transdisciplinary collaboration: a) biodiversity; b) urban ecological networks and connectivity; c) multifunctionality; d) redundancy and modularization; and e) adaptive design.

Hellmund and Smith (1993) state that Greenways “*hold the unique potential for maintaining ecological integrity in landscapes which are being (or have been) fragmented by human development.*” Searns (1995) concludes that multi-objective greenways go beyond beautification to address critical human concerns, such as reduction in flood damage, enhancement of water quality and conservation of biological diversity. Searns goes on to say that greenways brings together the fields of landscape architecture, wetland ecology and civil engineering to address landscape concerns that are critical to civilization.

Greenways are an excellent land use product of resilient communities. Greenways satisfy all of the city resilient framework strategies defined by the Rockefeller Foundation and should be thought of as green infrastructure, or “*an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife.*”<sup>17</sup> Greenways as green infrastructure provide the basis for large scale, interconnected landscape systems, that when strategically planned for coastal and shoreline communities can serve to absorb floodwaters, lessen the impact associated with stormwater damage, and keep residents out of hazardous landscapes.

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<sup>16</sup> Rockefeller Foundation, 2015

<sup>17</sup> Benedict and McMahon, 2006

What lessons can be learned from communities that have embraced greenways as green infrastructure, specifically for the purpose of mitigating the impacts of urban flooding? The following case studies feature three communities in the United States that have implemented greenways to address the impacts from urban flooding, thereby creating long term strategies that will make their communities more resilient and sustainable. The lessons learned by these communities can be replicated in urban areas world-wide.

### **Case Study: Louisville and Jefferson County Greenway System, Kentucky**

In March 1997 the Louisville and Jefferson County area suffered a 12-inch rainstorm event during a 31-hour period. Officially defined as a 100-year storm, floodwaters covered the majority of the county, resulting in \$200 million in damage to homes and businesses.<sup>18</sup> The Louisville and Jefferson County Metropolitan Sewer District (MSD) was originally established in 1936, in the aftermath of a devastating flood, with the purpose of preventing these catastrophic events from happening. Nearly 60 years later, the Executive Director of MSD, Gordon Garner, concluded that MSD was no closer to solving its urban flooding problems, despite the agency's six decades of work. Garner felt MSD needed a new guiding philosophy to reduce the impacts of urban flooding. He suggested a "Greenway Solution," based in part on Denver, Colorado's successful urban greenway program, as a comprehensive method of managing the repetitive flooding in Jefferson County, Kentucky.

In 1992, MSD, in cooperation with Jefferson County and the City of Louisville, developed the *Louisville and Jefferson County Multi Objective Stream Corridor/Greenways Program*. Under this program, MSD defined Greenways "as a system of connected lands with a purpose of providing ecological and cultural benefits. Located along creeks, streams and rivers, and connecting places of interest within the community, such as parks, historic places, etc., Greenways will be utilized by MSD to control flooding, improve water quality, protect wetlands, conserve habitat for wildlife, and as a buffer for land development."<sup>19</sup>

In conjunction with the Greenway program, MSD also launched a "*Watershed Approach to Stormwater Management*." Prior to this effort, MSD focused its efforts on the channelization of streams and construction of waterworks facilities designed to rid the county of excess rainwater. Under the Watershed Approach, MSD began to study how to harness the resources of six major watersheds in Jefferson County, each unique and different from the other. The

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<sup>18</sup> Louisville and Jefferson County Metropolitan Sewer District, 1997

<sup>19</sup> Louisville and Jefferson County Metropolitan Sewer District, 2016

900-person MSD organization was pared in half in the span of a decade, and was reorganized to focus its efforts on working with citizens to better understand each watershed and how best to address the cause and impact of urban flooding.

After two decades of work, the results of MSD's efforts are evident, as urban flooding has been reduced and fewer residents are exposed to repetitive flood loss. MSD's vision and mission has evolved with a modern clear purpose in mind: "*Achieving Clean, Safe Waterways for a Healthy and Vibrant Community while Providing Exceptional Wastewater, Drainage and Flood Protection Services for Our Community*"<sup>20</sup> In 2007, MSD issued a Sustainability Report outlining the agency's transformation plan, recognizing the impact of global climate change on flood hazard areas, and defining green infrastructure programs that would continue to mitigate future impacts. The MSD has implemented Searns (1995) vision of a modern multi-objective greenway system, emphasizing the ability to reduce flood damage and address critical human needs.

### **Case Study: Greater Grand Forks Greenway, North Dakota**

The Red River, located in North and South Dakotas in the United States, is the southern most main stem of an ancient fresh water lake, Agassiz. Carved by glaciers more than 11,000 years ago, Agassiz, covering parts of the Dakota's and Minnesota in the United States and the provinces of Saskatchewan and Manitoba in Canada, has become an area of renewed interest in the face of rapid global climate change.<sup>21</sup> In the past 100 years, numerous communities have developed along the banks of the Red River, including the twin communities of Grand Forks, North Dakota and East Grand Forks, Minnesota. In April and May 1997, a flood of epic scale, stretching for 6 miles from the banks of the Red River, submerged both communities, causing \$3.5 billion in property damages -- the most expensive flood event in United States history at the time.<sup>22</sup> In response to the flood, the United States Congressional delegation from North Dakota requested that the U. S. Army Corps of Engineers (USACE) employ a "Greenway Solution" to the flood event.

The USACE was faced with important decisions in response to the flood event, among them: a) should the two communities be moved and relocated away from the banks of the Red River, and therefore out of the bottom of the ancient lake bed, or b) should a system of extremely tall levees (the flood

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<sup>20</sup> Louisville and Jefferson County Metropolitan Sewer District, 2016

<sup>21</sup> Wikipedia, 2016, History of Lake Agassiz

<sup>22</sup> United States Army Corps of Engineers, 1998

crested at 14 meters (49 feet) above normal river flow) be constructed between the downtowns of Grand Forks and East Grand Forks, along the banks of the Red River, to channel future flood flows between the communities. Both options were impactful and very costly, and after considerable thought the decision was made to construct a system of levees 15.8 meters (52 feet) in height. As a result, a vast landscape of 890 hectares (2,200 acres) was created between the levees. This landscape was defined by USACE as the *Greater Grand Forks Greenway* and the development and management of this landscape was assigned to the adjacent communities.<sup>23</sup>

When it was initially proposed in 1998, the Greater Grand Forks Greenway (Figure 2) was more than twice the size of America's most famous urban landscape, Central Park in New York City. The immediate reaction of the local communities was extremely negative to the Greenway concept, with the mayors of both cities objecting to its creation. During the following years, local opposition to the Greenway continued unabated by the assurance that the project would be successful. Despite these objections, federal support for the project remained and the Greenway was officially completed and dedicated for public use in the spring 2003.

Today, the Greater Grand Forks Greenway provides numerous benefits to the community which extend beyond its primary function as a flood control landscape. The levee system has been tested by four flood events approximately equal in magnitude to the 1997 record event. The greenway satisfies the five principles defined by Ahern (2013): biodiversity, urban ecological networks and connectivity, multifunctionality, redundancy and modularization and adaptive design. More than 20 miles of urban trails crisscross the 890-hectare landscape. The Greenway is programmed with events year round, and for a temperature range that varies 160 degrees from winter to summer. The Greenway has positively changed the economic fortunes of Grand Forks, ND and East Grand Forks, MN. The Greenway is integral to the daily lives of community residents.<sup>24</sup> Perhaps most importantly, the USACE concludes that the Greater Grand Forks Greenway is "*about the best example we have to date*" of a cost effective flood protection project that serves as a public amenity.<sup>25</sup>

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<sup>23</sup> Greenways Incorporated, 2001

<sup>24</sup> City of Grand Forks, ND, 2015

<sup>25</sup> US Army Corps of Engineers, 2010

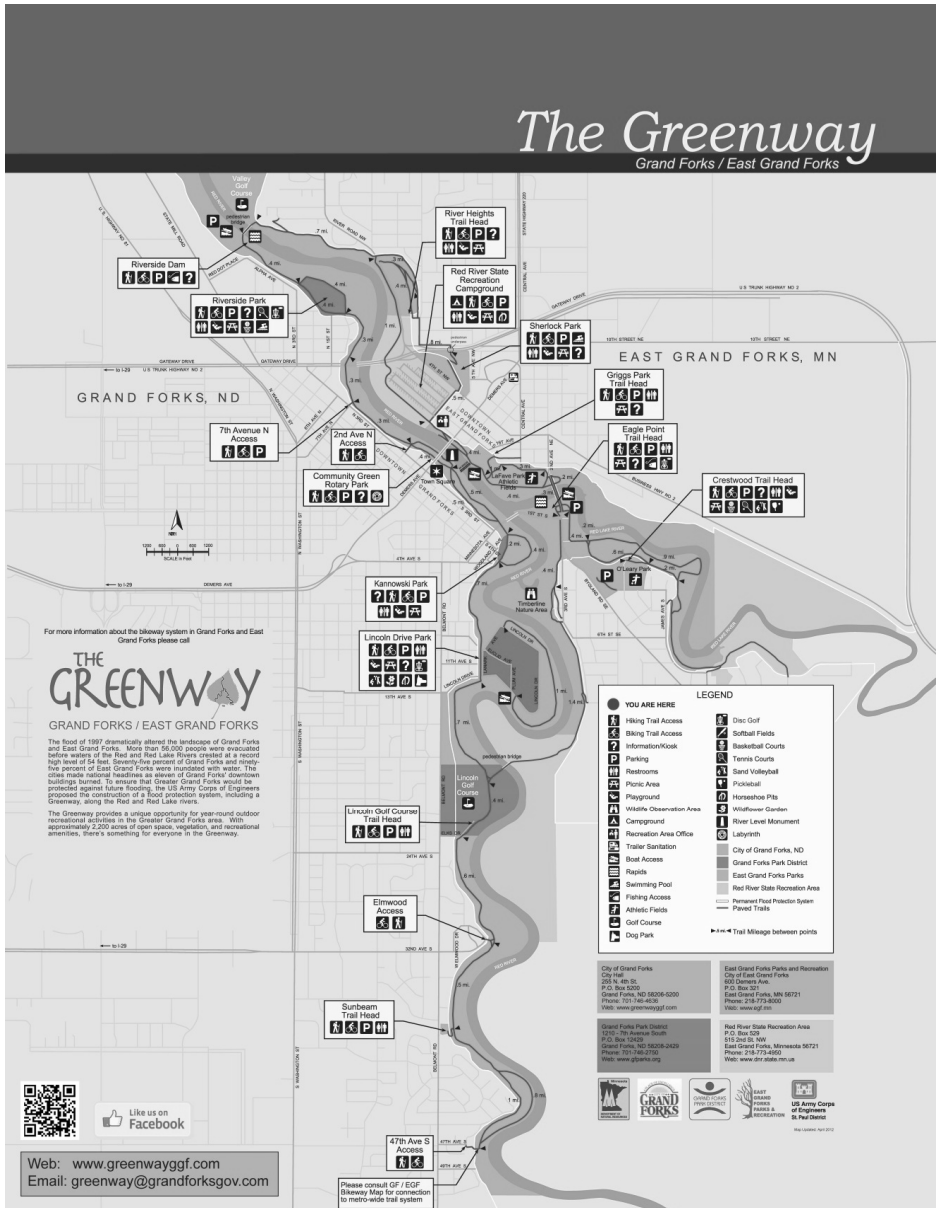


Figure 2: Greater Grand Forks Greenway (City of Grand Forks, North Dakota, USA)

## **Case Study: Wolf River Greenway, Memphis, Tennessee**

Memphis, Tennessee is one of the few large cities in the United States situated on the banks of the Mississippi River (the others being Minneapolis, St. Louis and New Orleans). As such, Memphis and many parts of Shelby County are subject to seasonal flooding from America's largest and longest river. These floods annually cause damage to property, and loss of life. In response to the impacts of urban flooding, the Shelby County Office of Sustainability developed a "*Greenprint for Resilience*" project which, during the next 25 years, will result in the development of a 500-mile network of green infrastructure projects to increase community resilience to future flooding, while at the same time providing amenities such as trails and recreation areas for the benefit of residents. This program includes relocating residents and businesses that have been prone to repetitive flooding, and creating new wetland and flood detention areas to provide increased storage areas of floodwaters. This is an ambitious program that will require substantial funding and community support.

The first step was to prepare a Greenprint for the region, entitled "*Mid-South Regional Greenprint.*" (Figure 3) The purpose of the Greenprint is to "*address long-term housing and land use, resource conservation, environmental protection, accessibility, community health and wellness, transportation alternatives, economic development, neighborhood engagement, and social equity in the Greater Memphis Area.*"<sup>26</sup> The map of this Greenprint illustrates the extent of the program over a three state, multi-county region. The network of interconnected greenway corridors is substantial, including the shoreline of the Mississippi River and major watersheds of the region, such as the Wolf River. In April 2015, the American Planning Association awarded the Mid South Regional Greenway the 2015 Excellence in Sustainability Award as a national model for resilient and sustainable communities.

The second step was to apply for a National Resiliency Grant from the United States Department of Housing and Urban Development. Shelby County was one of hundreds of applicants, and in January 2016 was one of the 13 regions in the United States awarded an implementation grant. The \$60 million (USD) grant, one of the largest financial grants in County history, will be used to implement four large scale projects in the region that lessen future flood damages. One of the projects involves the development of the Wolf River Restoration and Greenway.

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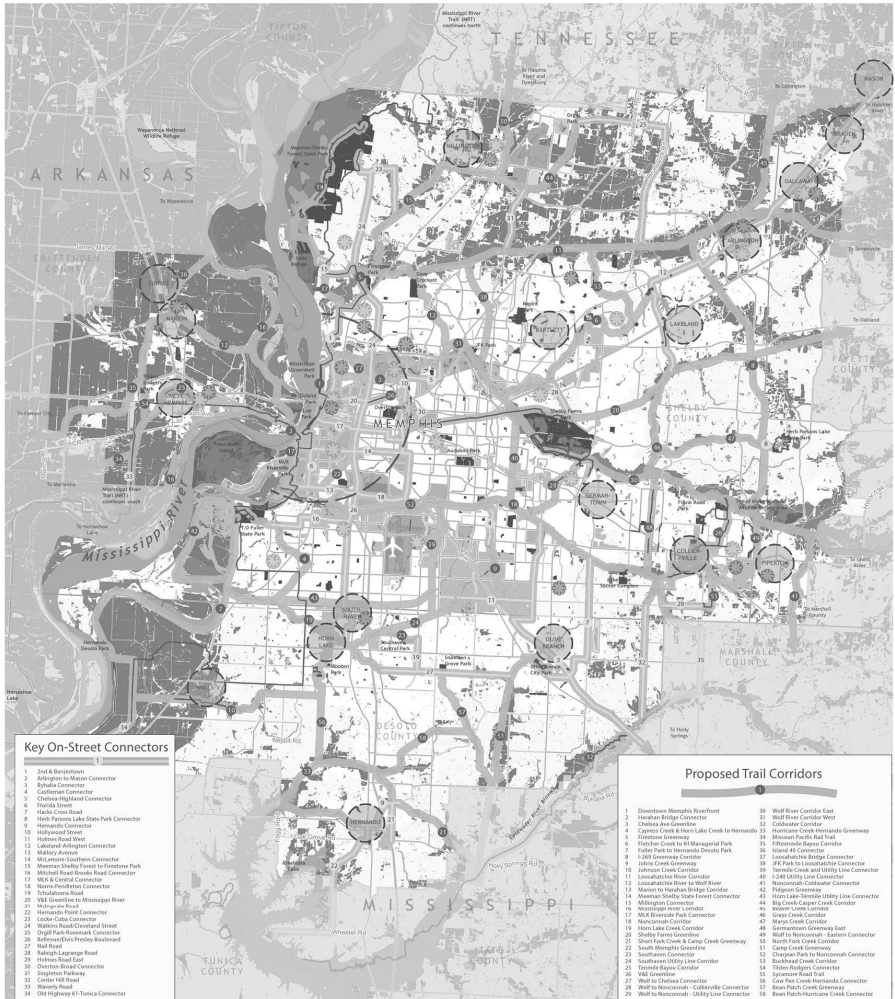
<sup>26</sup> Mid South Regional Greenprint, Shelby County, TN 2015





# MID-SOUTH REGIONAL GREENPRINT CONCEPT MAP

Concept for a Regional Network of Connected Green Infrastructure



**Key Inputs:**

- Community & Agency Greenprint
- Public Input
- Greenprint
- Long-Term Proposed (20-Year) Regional Trail System
- City Centers and Town Centers
- Employment Centers and High Priority Areas for Equity
- Other Greenprint Focus Areas
- Open Space Resources

**Proposed Trail Corridor:** Long-Term Proposed (20-Year) Regional Trail System. Refer to local trail plans for other proposed trails.

**Proposed Key On-Street Connectors:** These streets and pedestrian-friendly streets will connect the Regional Trail System where off-road routes are not possible.

**City Centers and Town Centers:** The largest city shows a 1-mile radius (20-minute walk) from center. The largest city shows a 5-mile (20-minute bike ride) from Downtown Memphis.

**Employment Centers and High Priority Areas for Equity:** Traditionally under-served areas and major employment centers are highlighted as priorities for connecting future green infrastructure.

**Other Greenprint Focus Areas:** These areas were identified by citizens as Greenprint working groups as areas of focus for revitalization and housing.

**Open Space Resources:** These resources from the 2010-2015 Greenprint study, and many of the links within the network, they are important for addressing the regions water, air, and soil and providing opportunities for recreation, physical fitness, health, and food production.

**Figure 3: Mid-South Regional Greenprint (Shelby County, Tennessee, USA)**

The Wolf River Greenway is a project originally envisioned in the 1980's that

has lacked both financial and community support for the past thirty years. In July 2014, the Greenway garnered much needed support from private philanthropic organizations and corporations in Memphis, who understood the long-term benefits of the project and provided financial backing to complete planning, design and construction documents. In the fall of 2014, a conceptual master plan for the Greenway was completed and during 2015 detailed design and construction documents were prepared. A groundbreaking ceremony occurred in September 2015 and construction of the restoration elements and greenway trail facilities and amenities is scheduled to commence in the spring of 2016.

As the first of four National Resiliency Grant projects, the Wolf River Greenway embodies the vision, goals and objectives of the federal program. The Greenway seeks to restore hundreds of acres of critically important watershed lands, removing structures and water flow impediments. The Wolf River Conservancy, a nationally accredited land trust organization, is in the process of purchasing hundreds of acres of privately owned land and transferring this land to public ownership for the purpose of flood protection. During the next three years, 22 miles of urban greenway trail will be constructed, providing residents and visitors with access to the Wolf River watershed, where an interpretive signage system will offer information about the river and the ecosystems of the watershed to educate citizens on the importance of wetlands and riparian landscapes.

### **Conclusion**

Global climate change will continue to have a significant impact on planet Earth's hydrologic cycle. Melting polar ice caps are leading to an increase in precipitation, more intense and destructive storm events, and excessive rainfall in the warm temperate regions of the planet.<sup>27</sup> As this paper has demonstrated, the effects of excessive rainfall events are already being experienced across the North American continent and in parts of Western and Central Europe. What actions can existing coastal and shoreline communities take to decrease the risks associated with urban flooding? One course of action is to plan, design and implement watershed oriented, regional greenway programs that focus on an ecological framework of protected landscapes to mitigate the impacts of excessive rainfall. Planning for and implementing regional greenways can reduce the impact of urban flooding, while at the same time providing a wide range of other important community benefits that improve the quality of life and economic vitality of a community or region.

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<sup>27</sup> NASA Earth Observatory, February 2015

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